U.S. Department of Transportation
National Highway Traffic Safety Administration

LANE DEPARTURE WARNING CONFIRMATION TEST

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Office of Vehicle Safety
Office of Crash Avoidance Standards
Room W43-478, NVS-120
1200 New Jersey Avenue, SE
WASHINGTON, DC 20590

LAND DEPATURE WARNING CONFIRMATION TEST

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1. PURPOSE AND APPLICATION

This laboratory test procedure provides the specifications for conducting testing for confirmation of the existence of Lane Departure Warning Hardware (LDW) on passenger vehicles under 10,000 pounds gross vehicle weight rating (GVWR). Although it is impossible to predict what technologies could be used in future LDW systems, it is believed that with minor modifications to the test setup, other technologies may be evaluated. Current technology is dependent on a sensor recognizing an edge line; this test relies on painted or taped lines being present much like public roadways. If a future technology such as magnetic markers, RADAR reflective striping, ultra violet paint, infra red, and/or some other technology became available, it is believed that the test herein could be modified to accommodate their evaluation.

The contract laboratories are directed by this test procedure to use a special test parameter which is a dynamic test to determine lane departure of a moving vehicle. The requirements of this indicant test procedure must be strictly adhered to; however, the test contractors are encouraged to suggest improved testing techniques to assist in procuring the required crash test data. Any changes to or deviations from this test procedure must be approved by the Contracting Officer's Technical Representative (COTR).

The contractor's in-house test procedure must have NHTSA approval prior to conducting the test of a particular fiscal year program. The contractor's test procedure cannot deviate in any way from the NHTSA procedure without the prior approval of the NHTSA COTR.

2. GENERAL REQUIREMENTS

Departing the lane is defined as any part of the vehicle polygon as defined in Section 12 crossing a lane boundary. Alternatively this could be as simple as the front wheel crossing over any part of the lane markings. First, a test series will be conducted to characterize the steering versus lateral velocity performance of the vehicle. The purpose of the test is to determine what handwheel angle will generate a lateral velocity equal to or greater than one meter per second. This value will be used to program the steering machine for the high departure rate tests.

Then the lane departure warning maneuvers are performance. To begin the maneuver, the vehicle is driven in a straight line at a constant speed attempting to maintain the desired entrance speed. The driver should control the vehicle in a straight line as they approach the start gate. The driver should not hit any cones that define the test start gate. Once the driver passes the retro-reflective line within the entrance gate; the steering machine will initiate its program. The driver will keep a constant speed throughout the maneuver. The test will be considered complete when the vehicle has completely departed the lane (entire vehicle is over the lane boundary.) The test will be conducted at two different levels of lateral velocities (low and high), two different roadway geometries (straight and curved), two different departure directions, and three different styles of roadway markings (continuous white lines, discontinuous yellow lines, and raised pavement markers). Each test condition will be repeated 5 times for a total of 120 trials.

3. SECURITY

The contractor shall provide appropriate security measures to protect test vehicles and equipment during the entire test program, and shall be responsible for all equipment removed from test vehicles before and after the crash test. Vehicle equipment thefts or act of vandalism must be reported to NHTSA authorities immediately. Under no circumstances shall any vehicle components be removed during a visitor inspection unless authorized by OCAS engineers. All data developed from the crash test program shall be protected.

NO INDIVIDUALS other than the contractor's personnel directly involved in the test program shall be allowed to witness a test, inspect, or photograph any test vehicle unless authorization is granted by a representative from the OCAS. It is the contractor's responsibility to secure the test site area during a test.

Rules for Contractors

1. No vehicle manufacturer's representative(s) or anyone other than the contractor's personnel working on the contracts and NHTSA personnel, shall be allowed to inspect NHTSA vehicles or witness vehicle preparations and/or testing without prior permission of the Office of Crash Avoidance Standards (OCAS). Such permission can never be assumed.

2. All communications with vehicle manufacturers shall be referred to the OCAS, and at no time shall the contractor release test data without the permission of the OCAS.

3. Unless otherwise specified, the vehicle manufacturer's representatives shall only be authorized to visit the contractor's test facility on the day that the test is scheduled, and the representatives must be escorted by NHTSA and/or contractor personnel.

4. Test vehicle inspection by the vehicle manufacturer's representative(s) shall be limited to 30 minutes prior to the start of vehicle test. Post-test inspection shall be limited to 1 hour after contractor personnel have completed their test tasks.

5. Photographs and videos of the test vehicle, associated test equipment and test event shall be allowed. However, test personnel shall not be included in any photographic coverage, and videotaping of vehicle preparation must be approved by OCAS. The contractor's personnel shall not respond to any questions from the manufacturer's representatives regarding this test program. All questions shall be referred to the COTR, an OCAS representative present at the test site, or to OCAS.

6. VISITATIONS -
   The contractor shall permit public access to and inspection of the test vehicles and related data during the times specified by the NHTSA COTR. NHTSA shall advise interested parties that such access and inspection shall be limited to a specified day, and specified hours and require prior approval from the Office of Crash Avoidance Standards. The contractor shall refer all visit requests from vehicle manufacturer's representatives and consumers to the Office of Crash Avoidance Standards. This service shall be included as an incidental part of the crash test program and will not result in any additional cost to the NHTSA. The contractor shall make his own arrangements with interested parties for expenses incurred beyond providing access and inspection services. All inquiries by manufacturers concerning the test program (vehicle, procedures, data, etc.) shall be directed to OCAS representatives.

4. GOOD HOUSEKEEPING

The contractor will maintain the entire test area, vehicle pre-test preparation facility, instrumentation building, and equipment configuration and performance verification test laboratory in a clean, organized and painted condition. All test instrumentation must be setup in an orderly manner consistent with good engineering practices.

5. TEST SCHEDULING AND MONITORING

The contractor shall commence testing within four (4) weeks after receipt of the first test vehicle. Subsequent tests will be conducted, if requested, at a minimum of one (1) vehicle test per week. The NHTSA COTR will make adjustments to the crash test schedule in cases of unusual circumstances such as inclement weather or difficulty experienced by the Agency in the procurement of a particular vehicle make and model. All testing shall be coordinated to allow monitoring by the COTR.

6 TEST DATA DISPOSITION

The contractor shall make all test data available within two hours after the test event if so requested by Agency personnel. Under no circumstances shall this data be furnished to non-Agency personnel. The contractor shall analyze the preliminary test results as directed by the COTR.

6.1 Computer Data Tape and Final Hard-Copy

The contractor shall deliver to OCAS the final data tape/diskette, digital printouts, and plots within one (1) week after the crash test.

6.2 Test Report

6.2.1 **T**est report shall include all of the items shown in the Sample Test Report. The contractor shall submit **eleven (11)** CD's and **one (1)** paper copy of the test report to the following address:

U. S. Department of Transportation
National Highway Traffic Safety Administration
Office of Crash Avoidance Standards (NVS-120)
1200 New Jersey Avenue, SE, Room W43-478
Washington, DC 20590

6.2.2 Report Submission

All final test reports shall be submitted to the above listed NHTSA office within **four (4) weeks** from the date of the vehicle crash test.

6.2.3 Text/Data Sheet CD

The contractor shall submit **one (1)** CD of the text and data sheet portion only of the test report in Microsoft Word format within **four (4)** weeks from the date of the vehicle test. The full test report including photographs and data traces on a disk may be a future requirement.

6.3 Test Video

OCAS shall receive one **(1)** copy of the color video or movie film for each test, and the copies shall be mailed directly to the OCAS within **four (4)** weeks of the vehicle test. The master print for each of the crash test videos shall be retained by the contractor, but will be made available to the OCAS upon request.

6.4 Data Loss

6.4.1 Conditions for RETEST

The test vehicle is instrumented in order to obtain data needed. The data from tests, specifically from those channels providing lateral velocity and handwheel angle are absolutely essential to the test program. An invalid test is one which does not conform precisely to all requirements/specifications of the laboratory test procedure and Statement of Work applicable to the test.

The contracting officer of NHTSA is the only NHTSA official authorized to notify the contractor that a retest is required.

No test report is required for any test which is determined to be invalid unless NHTSA specifically decides to require the Contractor to submit such report. Invalidated test reports will not be publicly released.

RETEST CONDITIONS

Failure of the contractor to obtain the above data and to maintain acceptable limits of test parameters in the manner outlined in this test procedure shall require a retest at the expense of the contractor and will include the cost of the vehicle replacement and retest at the contractor's expense. The provisions of this paragraph apply to, but are not limited to, the contractor maintaining proper speed tolerance, and test data acquisition, reduction, and processing.

The contractor shall also be responsible for obtaining usable data from all primary channels from each of the accelerometers and the steering controller. Failure to produce such data shall also be at the expense of the contractor and shall include vehicle replacement and retest unless the Office of Crash Avoidance Standards determines that the data loss occurred through conditions beyond reasonable and foreseeable control of the contractor. Should it become necessary for the contractor to procure another test vehicle, it must have identical equipment and options as the original vehicle. The retested vehicle shall be retained without fee by the testing facility until its disposal is authorized by the COTR.

6.4.2 Conditions for PARTIAL PAYMENT

The contractor shall exercise reasonable and foreseeable control to insure that no data is lost or rendered useless. If some non-critical data (such as camera failure) and critical data (acceleration data) are not obtained for the crash test and the test is accepted by the Agency, the Agency will not pay for the missing or lost data.

6.5 Data Retention by Contractor

The contractor shall retain at no extra cost to the agency, reproducible copies of all data tapes (analog and digital), videos, and still photograph negatives or electronic files .

6.6 Data Availability to the Public

The contractor shall provide interested parties with copies of test report, test CD's, test data tapes, test films, and test still photographs, at a reasonable cost to the purchaser, but only after the Office of Crash Avoidance Standards representative has advised the contractor that the results of that particular test have been released to the public by the Agency.

6.7 Indicant Failure Notification

Any indication of a "test failure" shall be communicated by telephone to COTR within 24 hours of the test.

NOTE: In the event of a failure, a post-test calibration check of some critically sensitive test equipment and instrumentation may be required for verification of accuracy. The necessity for the calibration shall be at the COTR's discretion and shall be performed without additional cost.

7. VEHICLES AND EQUIPMENT (GFP)

ACCEPTANCE OF TEST VEHICLES

The Contractor has the responsibility of accepting Leased or NHTSA-provided test vehicles from either new car dealers or vehicle transporters. In both instances, the Contractor acts in the Agency's behalf when signing an acceptance of test vehicles. The Contractor must check to verify the following:

A. All options listed on the "window sticker" are present on the test vehicle.
B. Tires and wheel rims are the same as listed.
C. There are no dents or other interior or exterior flaws.
D. The vehicle has been properly prepared and is in running condition.
E. Verify that spare tire, jack, lug wrench, and tool kit (if applicable) is located in the vehicle cargo area.

The Contractor shall check for damage that may have occurred during transit or prior use. The COTR is to be notified of any damage prior to preparation of the vehicle for testing.

NOTIFICATION OF COTR

The COTR must be notified within 24 hours after a vehicle has been delivered.

GOVERNMENT FURNISHED EQUIPMENT (GFE)

For the Forward Crash Warning Tests, no Government Furnished Equipment will be available or provided.

8. CALIBRATION AND INSTRUMENTATION

Before the Contractor initiates the test program, a test instrumentation calibration system must be implemented and maintained in accordance with established calibration practices. Guidelines for setting up and maintaining such calibration systems are described in MIL-C-45662A, “Calibration System Requirements.” The calibration system shall be set up and maintained as follows:

A. Standards for calibrating the measuring and test equipment will be stored and used under appropriate environmental conditions to assure their accuracy and stability.

B. All measuring instruments and standards shall be calibrated by the Contractor, or a commercial facility, against a higher order standard at periodic intervals not exceeding 6 months for instruments and 12 months for the calibration standards. Records, showing the calibration traceability to the National Institute of Standards and Technology (NIST), shall be maintained for all measuring and test equipment. The calibration frequency can be increased if deemed necessary by NHTSA.

1. FREQUENCY RESPONSE - The accelerometer sensitivity is monitored as the frequency is cycled from approximately 10 to 10000 HZ. The sensitivity should remain fixed.

2. LINEARITY - The accelerometer placed on a shaker table, is cycled from 5g to 100g at100HZ. There should be minimal sensitivity variation throughout the cycle as described in SAE J211. The sensitivity of the accelerometer should also be compared to previous calibration values, and to the manufacturer's initial submitted value. If a variation greater than approximately 2 to 5% (not specified) is recorded, than the accelerometer should not be used. In addition, the zero offset of the unit should be compared to previous values.

3. TRANSIENT WIDE BAND FREQUENCY DROP TEST - For this test, the accelerometer alongside a known standard and utilizing a drop tower, is dropped from varying heights. The accelerometer output is compared to the standard. In this setup, both frequency response and the amplitude linearity can be checked. The amplitude frequency response should beat a minimum up to CLASS 1000 as defined by SAE J211. The amplitude response of the accelerometer from the different drop heights can be used to compute the amplitude linearity tolerance. The drop heights are arbitrary, but it is recommended that the accelerometer be dropped from at least one height which produces a g level that is greater than that expected in the actual test environment.

4. SENSOR HISTORY - A sensor calibration history should be maintained. During each calibration, prior values should be referenced. If wide disparities exist between values, then the sensor should not be used.

C. All measuring and test equipment and measuring standards will be labeled with the following information:

(1) Date of calibration

(2) Date of next scheduled calibration

(3) Name of the technician who calibrated the equipment

D. A written calibration procedure shall be provided by the Contractor which includes as a minimum the following information for all measurement and test equipment:

(1) Type of equipment, manufacturer model number, etc.

(2) Measurement range

(3) Accuracy

(4) Calibration interval

(5) Type of standard used to calibrate the equipment (calibration traceability of the standard must be evident)

(6) The actual procedures and forms used to perform the calibrations.

E. Records of calibration for all test instrumentation shall be kept by the Contractor in a manner that assures the maintenance of established calibration schedules. All such records shall be readily available for inspection when requested by the COTR and shall be included in the final test report as shown in **APPENDIX A**. The calibration system will need the acceptance of the COTR before testing commences.

F. Test equipment shall receive a pre- and post-test zero and calibration check. This check shall be recorded by the test technician(s) and submitted with the final report as described in section 11.13.

NOTE: In the event of a failure to meet the standard's minimum performance requirements additional calibration checks of some critically sensitive test equipment and instrumentation may be required for verification of accuracy. The necessity for the calibration will be at the COTR's discretion and will be performed without additional cost.

9. PHOTOGRAPHIC DOCUMENTATION

Each shall be documented on a color video camera. Sun or light glare must be minimized so that views of the test are visible for visual analysis.

9.1 CAMERAS REQUIRED

CAMERA 1
Real-time video inside of the subject vehicle.

CAMERA 2
Real-time video behind the test vehicle.

CAMERA 3
Real-time video camera to one side of the most significant even area of the test.

CAMERA 4
A still camera to document the vehicle.

9.3 INFORMATIONAL PLACARDS

Vehicle identification placards shall be positioned so that at least 1 placard will be visible in the field-of-view for at least one video camera The following information will be shown:

A. Vehicle's NHTSA Number

B. The words "OCAS Lane Departure Warning Confirmation "

C. Date of test

D. Name of contract laboratory

E. Vehicle year, make and model

9.9 TEST FILM TITLE AND ENDING

Test video shall include the following title frames:

A. "The following Lane Departure Warning test was conducted under contract with the National Highway Traffic Safety Administration by (name and location of test laboratory)"

B. LANE DEPARTURE WARNING TEST

TEST VEHICLE MODEL YEAR, MAKE AND MODEL

NHTSA No. CXXXXX

DATE OF IMPACT EVENT

C. The ending frame shall state “THE END”

9.10 FILM EDITING

The film shall be edited in the following sequence:

A. Title

B. Pretest Coverage

C. Real Time Pan Coverage

D. Post test Coverage

E. “The End”

Any vehicle failures shall be completely documented.

9.11 STILL PHOTOGRAPHS

Provide still photographs (8 x 10 or $8^1/_2$ x 11 inch color prints properly focused for clear images) of pretest and post-test condition of entire vehicle deformation and details that pertain to the tested standards. Photographs of all areas of the test vehicle that may be of importance to the frontal barrier impact test should be taken in excess and developed only if the need arises.

The following still photographs are required for the test:

A. Pretest left side view of test vehicle

B. Pretest right front three-quarter view of test vehicle

C. Photograph of equipment installed in vehicle

D. Photograph of certification label

E Photograph of tire placard

F Photograph of the vehicle in a test mode

10. DEFINITIONS

10.1 Terms
LDW is a driver assistance system that warns the driver when their vehicle is about to drift beyond the delineated edge lines of the current travel lane.

ISO – Lane Departure Warning – A warning given to the driver in accordance with the lane departure warning condition in the absence of suppression requests. [7]

SAE – uses ISO Draft Standard N123.35 [12]

FMCSA - LDWS are in-vehicle electronic systems that monitor the position of a vehicle within a roadway lane and warn a driver if the vehicle deviates or is about to deviate outside the lane. Currently available LDWS are forward looking, vision-based systems that use algorithms to interpret video images to estimate vehicle state (lateral position, lateral velocity, heading, etc.) and roadway alignment (lane width, road curvature, etc.). LDWS warn the driver of a lane departure when the vehicle is traveling above a certain speed threshold and the vehicle's turn signal is not in use. In addition, LDWS notify the driver when lane markings are inadequate for detection, or if the system malfunctions. [10].

11. PRETEST AND FACILITY REQUIREMENTS

11.1 DETAILED TEST AND QUALITY CONTROL PROCEDURES REQUIRED

Prior to conducting any test, Contractors are required to submit a detailed in-house test procedure to the COTR which includes:

A. A step-by-step description of the methodology to be used.

B. A written Quality Control (QC) Procedure which shall include calibrations, the data review process, report review, and the people assigned to perform QC on each task.

C. A complete listing of test equipment which shall include instrument accuracy and calibration dates.

D. Detailed checkoff lists to be used during the test and during data review. These lists shall include all test procedure requirements. Each separate checkoff sheet shall identify the lab, test date, vehicle and test technicians. These check sheets shall be used to document that all requirements and procedures have been complied with for each test. The check sheets should be kept on file.

There shall be no contradiction between the laboratory test procedure and the Contractor's in-house test procedure. The procedures shall cover all aspects of testing from vehicle receipt to submission of the final report. Written approval of the procedures must be obtained from the COTR before initiating the test program so that all parties are in agreement.

11.2 Vehicle Test Configurations

11.2.1 Load Configurations

The test vehicle shall contain the test driver and required instrumentation.

11.3 Road Test Surface

Tests are conducted on a dry, uniform, solid-paved surface. Surfaces with irregularities, such as dips and large cracks, are unsuitable, as they may confound test results. The test surface shall have line markings defining a single road edge.

11.3.1 Line Markings

All test maneuvers are to be performed using 3 different types of lane markings. All lines shall meet USDOT specifications as required by the Manual on Uniform Traffic Control Devices (MUTCD) and be considered in "very good condition". Under conduct of each test, only one edge line should be seen by the LDW system. Tests should be conducted with line markings on both the left and the right side of the vehicle.

11.3.1.1 Lane Marker Width

The width of the edge line marker shall be 10 cm – 55 cm. This is considered to be a normal width for longitudinal pavement markings under Section 3A.05 of the MUTCD [15].

11.3.1.2 Broken Lines (dashed lines)

Broken lines (dashed) should follow the recommended length as stated in the MUTCD. Broken lines should be 10 ft line segments and 30 ft. gaps, or dimensions that are similar in ratio as appropriate for traffic speeds and need for delineation [15].

11.3.1.3 Raised Pavement Markers

Based on California Standard Plans, [What is this?] raised pavement markers may be used in place of painted strips in marking California roads. Other states, mainly in the southern part of the United States rely on them as well. These markers may be white or yellow, depending on the specific application, following the same basic colors of their analogous white and yellow painted lines.
Following the California 2006 Standard Plans, 3 types of raised pavement markings are used to form roadway lines. It is believed that these types of roadway markings are the hardest for a sensor system to process. Type A and Type AY are non-reflective circular domes that are approximately 4" in diameter and approximately 0.7" high. Type C and D are square markings that are retroreflective in two directions measuring approximately 4" x 4" x 0.5" high and Type G and H that are the same as C and D only retroreflective in a single direction.

11.3.1.4 Line Marking Color and Reflectivity

Lane marker color and reflectivity shall meet all applicable standards. These standards include those from the International Commission of Illumination (CIE) for color and the American Society for Testing and Materials (ASTM) on lane marker reflectance. Methods for determining lane marker characteristics are discussed in the RDCWS FOT by NIST [8].

11.3.2 Line Styles for Maneuver

11.3.2.1 Continuous White Line

A continuous white line will considered a white line that is 4 in thickness and runs for the entire length of the test course to be used.

11.3.2.2 Dashed Yellow Line

A dashed yellow line will be considered a discontinuous yellow line as defined in section 10.3.1.2.

11.3.2.3 Continuous Line (raised pavement markers)

For the test, raised pavement markers will be setup following California Standard Plan A20A, Detail 4. as shown in Figure 1 (Where the squares are Type D yellow reflectors and the circles are yellow type AY discs.

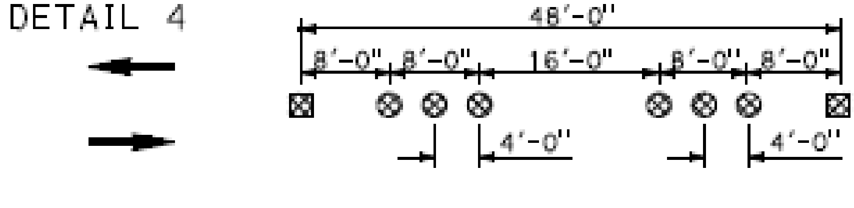

Figure 1

11.3.3 Pavement Friction

All maneuvers are to be performed on a dry, high-friction road test surface. Unless otherwise specified, the road test surface produces a peak friction coefficient (PFC) of approximately 0.9 when measured using an ASTM E1136 standard reference test tire, in accordance with ASTM Method E 1337–90, at a speed of 64.4 km/h (40 mph), without water delivery.

11.4 Ambient Conditions

11.4.1 Ambient Temperature

The ambient temperature shall be between 0° C (32° F) and 40° C (104° F).

11.4.2 Wind Speed

The maximum wind speed shall be no greater than 10 m/s (22 mph).

11.4.3 Inclement Weather

Tests should not be conducted during periods of inclement weather. This includes rain, snow, hail, fog, smoke, ash, etc.

11.4.4 Visibility

Tests should be conducted in daylight and under ideal conditions.

11.5 Calibration Data

It is strongly recommended that calibration data be collected prior to tests of each configuration to assist in resolving uncertain test data.

• The distance measured by the speed sensor along a straight line between the end points of a surveyed linear roadway standard of 1000 feet or more (observed and recorded manually from the speed sensor display).

• Five to fifteen seconds of data from all instrument channels as the configured and prepared test vehicle is driven in a straight line on a level, uniform, solid-paved road surface at 60 mph.

10.6 Vehicle Gear Selection

All tests are performed with automatic transmissions in ‘‘Drive’’ or with manual transmissions in the highest gear capable of sustaining the desired test speed.

Manual transmission clutches are to remain engaged during all maneuvers.

11.7 INSTRUMENTATION REQUIRED

Each test vehicle is to be equipped with sensors, a data acquisition system, and a programmable steering machine. Equipment location and weight specifications are presented in Table I.1 and Figure I.1.

11.7.1 Vehicle Load Configuration

Use a nominal load configuration. Loading does not affect LDW system performance.

11.7.1.1 Nominal Load Configuration

The Nominal Load Configuration consists of the driver, instrumentation, steering machine, and a full tank of fuel. Weight and location specifications for the data acquisition system and steering machine are presented in Table I.1 and Figure I.1.

Table I.1. – Equipment Location and Weight

Equipment	Location	Weight, typical (lbs.)
Data Acquisition System	Rear Passenger Side Seat	58
Steering Machine	Handwheel	31
Steering Machine Electronics Box	Passenger row foot well behind the front passenger seat. If vehicle does not have a rear passenger row foot well, the Electronics Box should be placed in the front passenger seat foot well.	39

11.7.2 Data Collection

All data is to be sampled at 100 Hz. Signal conditioning consists of amplification, anti-alias filtering, and digitizing. Amplifier gains are selected to maximize the signal-to-noise ratio of the digitized data. Filtering is performed with two-pole low-pass Butterworth filters with nominal cutoff frequencies selected to prevent aliasing. The nominal cutoff frequency is 15 Hz (calculated breakpoint frequencies are 18 and 19 Hz for the first and second poles respectively). Data collection is initiated manually by the test driver immediately before the start of the maneuver or automatically by ‘‘Handwheel Command Flag’’ signal from the steering machine (refer to Section 3.2.4.2.2, Handwheel Command Flag).

11.7.3 Sensors and Sensor Locations

A brief description of these sensors is provided in this section.

Table I.2 – Recommended Sensor Specifications

Type	Output	Range	Resolution	Accuracy
Angle Encoder	Handwheel Angle	+/- 800 deg	0.25 deg	+/- 0.25 deg
Non-contact Speed Sensor	Vehicle Speed	0.1 – 65 mph	0.1 mph	+/- 0.25% of full scale
Multi-Axis Inertial Sensing System	Longitudinal, Lateral, and Vertical Acceleration. Roll, Yaw, and Pitch Rate	Accelerometers: +/- 2G. Angular Rate Sensors: +/- 100 deg/s.	Accelerometers: ≤ 10 μg. Angular Rate Sensors: ≤ deg/s.	Accelerometers: ≤ 0.05% of full range. Angular Rate Sensors:0.05% of full range
Optical Velocity and Slip Angle Sensor	Lateral Velocity	0 – 10V	.1 MPH	+/-0.25%
Data Flag (Handwheel Command Flag)	Signal from sensor that initiates maneuver when driven over a retro-reflective	0 – 10V	N/A	Output response better than 10 ms.

	marker			
Data Flag (Lane Departure)	Signal from LDW system that indicates if an LDW warning was issued	0 – 10V	N/A	Output response better than 10 ms.
Vehicle Dimensional Measurements	2-D polygon describing the vehicle	N/A	0.05 inch	0.05 inch
Video Camera L/R	Left and Right downward looking view of the vehicles front tires	N/A	N/A	N/A

11.7.3.1.1 Handwheel Angle

Handwheel position is measured via an angle encoder integral with the programmable steering machines.

11.7.3.1.2 Vehicle Speed

Vehicle speed is measured with a non-contact speed sensor. Use of Doppler radar based sensors placed at the center rear of each vehicle or GPS based sensors that have an update rate ≥ 100 HZ are acceptable.   Sensor outputs are to be transmitted not only to the data acquisition system, but also to a dashboard display unit. This allows the driver to accurately monitor vehicle speed.

11.7.3.1.3 Chassis Dynamics

A multi-axis inertial sensing system is used to measure linear accelerations and roll, pitch, and yaw angular rates. The position of the multi-axis inertial sensing system must be accurately measured relative to the C.G. of the vehicle in the Nominal Load Configurations. These data are required to translate the motion of the vehicle at the measured location to that which occurred at the actual C.G to remove roll, pitch, and yaw effects. The following equations are used to correct the accelerometer data in post-processing. They were derived from equations of general relative acceleration for a translating reference frame and use the SAE Convention for Vehicle Dynamics Coordinate Systems. The coordinate transformations are:

$$x''_{corrected} = x''_{accel} - \left(\Theta'^2 + \Psi'^2\right)x_{disp} + \left(\Theta'\Phi' - \Psi''\right)y_{disp} + \left(\Psi'\Phi' + \Theta''\right)z_{disp}$$

$$y''_{corrected} = y''_{accel} + \left(\Theta'\Phi' + \Psi''\right)x_{disp} - \left(\Phi'^2 + \Psi'^2\right)y_{disp} + \left(\Psi'\Theta' - \Phi''\right)z_{disp}$$

$$z''_{corrected} = z''_{accel} + \left(\Psi'\Phi' - \Theta''\right)x_{disp} + \left(\Psi'\Theta' + \Phi''\right)y_{disp} - \left(\Phi'^2 + \Theta'^2\right)z_{disp}$$

where,

x''corrected, y''corrected, and z''corrected = longitudinal, lateral, and vertical accelerations, respectively, at the vehicle’s center of gravity

x''accel, y''accel, and z''accel = longitudinal, lateral, and vertical accelerations, respectively, at the accelerometer location x″disp, y″disp, and z″disp = longitudinal, lateral, and vertical displacements, respectively, of the center of gravity with respect to the accelerometer location

φ′ and φ″=roll rate and roll acceleration, respectively

Θ′ and Θ″ = pitch rate and pitch acceleration, respectively

Ψ′ and Ψ″ = yaw rate and yaw acceleration, respectively

Inertially stabilized accelerometers are not used for this test procedure. Lateral acceleration must be corrected for vehicle roll angle during data post-processing. This is discussed in Section 4.12.

11.7.3.1.4 Lateral Velocity

A non-contact sensor that can measure the vehicles lateral velocity with respect to the roadway plane is used for this test. Optical based lateral velocity sensors are acceptable. It is believed that using a lateral velocity referenced from the roadway plane will produce enough accuracy needed to perform this test.

Lateral velocity with respect to the road edge can be calculated using high precision, high update rate (20 Hz), post-processed differential corrected global position satellite (GPS) data. Using a static survey of the road edge, data from the vehicle is compared to the survey. Lateral distance and angle in regards to the road edge are calculated and then used to compute a lateral velocity using trigonometry.

$$V_{lat} = V_{fwd} * \text{Tan}\ \Theta$$

Where:

V_{lat} = Lateral velocity perpendicular to the vehicle in reference to the road edge.
V_{fwd} = Forward velocity of the vehicle.
Θ = Angle between the vehicle heading and the road edge.

Newer sensor technology that can combine inertial sensor data and real time kinematic GPS data and combine them to compute accurate position, range, and velocity data in real time can also be used. Sensor systems using this technology can produce both lateral velocity data with respect to the ground plane as well as the surveyed road edge.

11.7.3.2 Handwheel Command Flag

The Handwheel Command Flag is a signal sent to the steering machine to instruct the machine to begin its steering program. An optical beam pickup sensor mounted on the center front of the vehicle can be used. Any sensor must be capable of outputting a voltage signal (open collector) with 5 ms response time after crossing a retro-reflective line placed on the test surface.

11.7.4 Steering Machine

A programmable steering machine is used to generate handwheel steering inputs for all test maneuvers. The machine must provide at least 35 lbf-ft of torque at a handwheel rate of 125 deg/sec and be able to control each vehicle's steering system in 1 degree increments up to 16 degrees of steering. It is recommended that the steering machine be capable of initiating steering programs from an external control signal and have the convenience of changing the steering program during test sessions.

11.7.5 Vehicle Dimension Measurements

For purposes of this test, the vehicle dimensions should be a 2D polygon that is defined by the X and Y dimensions relative to the C.G. of the vehicle using the standard SAE coordinate system. The corners of the polygon are defined by the X and Y locations where the plane of the outside edge of each tire makes contact with the road. This plane is defined by running a perpendicular line from the outer most edge of the tire to the ground. A FARO measurement arm can be used to make these measurements.

11.7.6 Video Measures

As an option, a video channel(s) may be recorded with a time synchronized audio track detailing when an audible or visual alert was issued in respect to the video image. The National Institute of Standards and Technology has successfully demonstrated such a system for assessing the system performance used in the Road Departure Collision Warning System (RDCWS) Field Operational Test (FOT) [14]. This system is capable of photometric measurements of the range and range- rate with respect to the lane edge line. Using a quad image processor, 4 field-of-views may simultaneously be observed. This simplifies data reduction in that 2 field of views are used to view the left and right side of the vehicle, 1 field of view is able to monitor the front

11.7.7 Driver Vehicle Interface

The LDW system shall provide a warning to the driver by either an auditory alert, haptic vibration, or haptic vehicle cue (i.e. braking that induces a yaw moment.).

11.7.7.1 Alert Suppression

11.7.7.1.2 Normal Operation

The alert to the driver may be suppressed under the following conditions.

a. directional turn-signal usage
b. On/Off – user has the option to manually turn the system off.
c. Speed < 45 mph

11.7.7.1.3 Failure Mode Operation

If the LDW system determines that it is operating in a failure mode, the system shall suppress warnings and indicate the failed condition by illuminating a dash board tale-tale.

12. TEST EXECUTION AND TEST REQUIREMENTS

12.1 VEHICLE CHARACTERIZATION

A test series will be conducted to characterize the steering versus lateral velocity performance of the vehicle. The purpose of the test is to determine what handwheel angle will generate a lateral velocity >= 1.0 m/s. This value will be used to program the steering machine for the high departure rate tests. The low departure rate tests will use a handwheel angle of 1 degree.

12.1.1 Maneuver Description

Vehicle characterization will be conducted at a constant speed of 45 mph and will consist of a total of 32 trials (16 left and 16 right). To begin the maneuver, the vehicle is accelerated to 45 mph. The test driver should control the vehicle in a straight line as they approach the entrance gate. The driver should not hit any cones that define the test entrance gate. If a cone is hit, the trial should be re-run. Once the driver passes the retro-reflective line within the start gate; the steering machine will initiate its program. The driver will keep a constant speed during the maneuver. The test will be considered complete when the vehicle has completely departed the lane (entire vehicle is over the lane boundary.) Starting at 1 degree steering, each successive trial will increment the handwheel by 1 degree up to 16 degrees. Steering rates for all maneuvers will be 125 deg/sec. Trials should be conducted both to the left and to the right.

Data collected from these trials should include: vehicle speed, instantaneous lateral velocity at the 6 foot left or right position of the lane, and handwheel angle (or the appropriate data to compute these values). Vehicle speed should be used to identify bad trial data. Vehicle speed should remain between 43 and 47 mph for the entire maneuver. Data from trials where speed was outside of the performance specification should not be included. If more than 3 vehicle speed values are invalid for a series of trials (one direction), the series should be re-run.

12.1.2 Measured Parameters

Analyses of this vehicle characterization test output an estimate of the vehicles lateral velocity for a given handwheel angle at the approximate time of a road departure event.

Data from both the left and right side trials should be averaged for each individual handwheel angle. From the averaged left and right departure data, a linear regression should be used to determine the HW angle for further tests. The nearest integer value of handwheel angle should be computed that was observed to produce a lateral velocity that was greater or equal to 1.0 m/s. (see figure below).

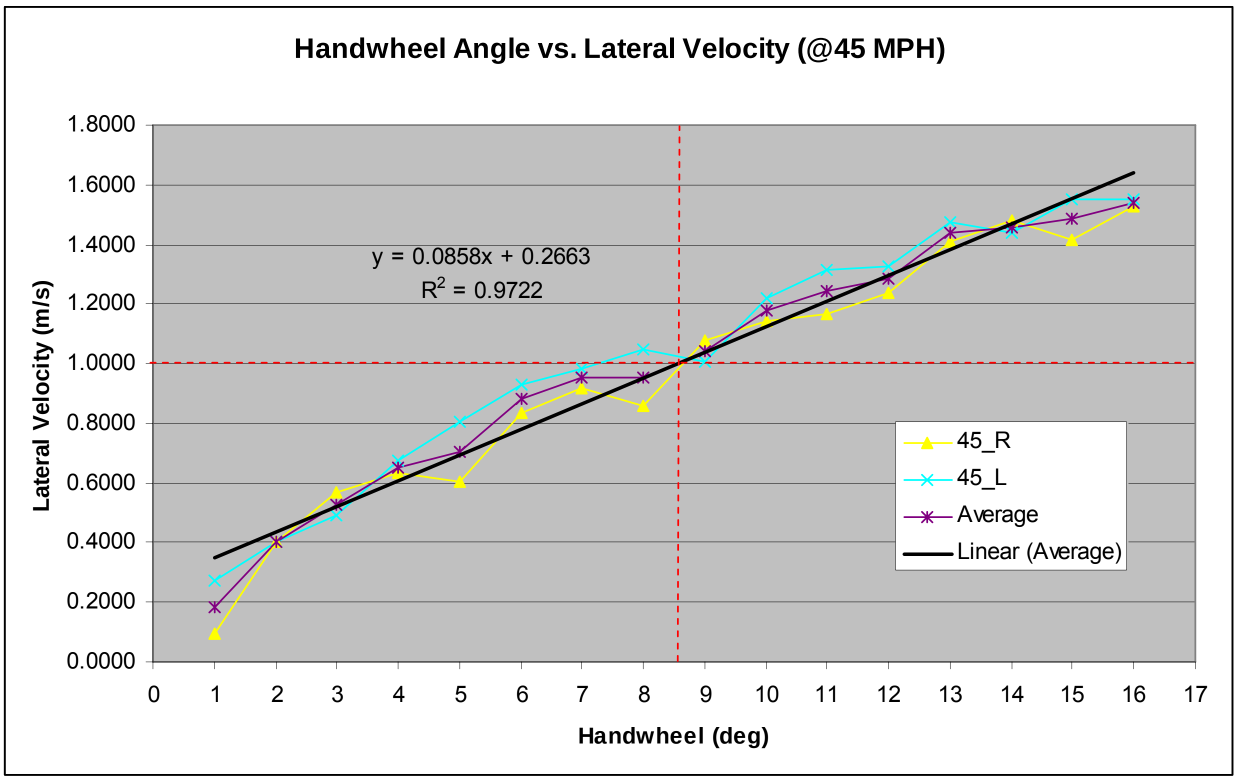

Figure 2 – Sample Lateral Velocity Plot

Data from a series of tests is displayed in the figure above. Lateral velocity data can be observed for each handwheel angle trial that were conducted both to the left and to the right. Using the linear interpolation line from the computed average values, it can be observed that lateral velocity exceeds 1.0 m/s at a handwheel value just greater than 8.5 degrees. Observing the graph it can be seen that the nearest integer value of handwheel angle that resulted in a lateral velocity greater the 1.0 m/s would be 9 degrees. This value will be used for performing the high lateral velocity drift tests.

12.2 LDW Maneuver

12.2.1 Maneuver Overview

To begin the maneuver, the vehicle is driven in a straight line at a constant speed attempting to maintain the desired entrance speed. The driver should control the vehicle in a straight line as they approach the start gate. The driver should not hit any cones that define the test start gate. Once the driver passes the retro-reflective line within the entrance gate; the steering machine will initiate its program. The driver will keep a constant speed throughout the maneuver. The test will be considered complete when the vehicle has completely departed the lane (entire vehicle is over the lane boundary.) The test will be conducted at two different levels of lateral velocities (low and high), two different roadway geometries (straight and curved), two different departure directions, and three different styles of roadway markings (continuous white lines, discontinuous yellow lines, and raised pavement markers). Each test condition will be repeated 5 times for a total of 120 trials. Table 2 displays the basic test matrix to be complete.

TABLE 2. LDW Test Matrix

<table>
<tr><th>Geometry</th><th>Direction</th><th>Lateral Velocity</th><th>Line Type</th><th>Trial 1</th><th>Trial 2</th><th>Trial 3</th><th>Trial 4</th><th>Trial 5</th></tr>
<tr><td rowspan="12">Straight</td><td rowspan="6">L</td><td rowspan="3">Low</td><td>Solid</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Dashed</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Bott Dot</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="3">High</td><td>Solid</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Dashed</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Bott Dot</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="6">R</td><td rowspan="3">Low</td><td>Solid</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Dashed</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Bott Dot</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="3">High</td><td>Solid</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Dashed</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Bott Dot</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="12">Curve</td><td rowspan="6">L</td><td rowspan="3">Low</td><td>Solid</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Dashed</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Bott Dot</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="3">High</td><td>Solid</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Dashed</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Bott Dot</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="6">R</td><td rowspan="3">Low</td><td>Solid</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Dashed</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Bott Dot</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="3">High</td><td>Solid</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Dashed</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Bott Dot</td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

12.2.1.1 Test Speed

All tests will be conducted at 45 mph. Test speed shall be monitored and a test will be considered valid if the test speed remains within +/- 2 mph from 45 mph gate speed. The speed must remain within this window from the start of the test until any part of the car, as defined by the 2-dimensional geometry (section 12.2.1.2) has crossed the edge line.

12.2.1.2 Test Course

12.2.1.2.1 Straight Scenario Test Setup

The straight test course shall be setup within an area that facilitates adequate area to allow the test vehicle to easily reach 45 mph, provide a minimum 1000 feet of area after the test starting point, and provide a safe amount of area laterally (>15 ft.) to ensure the vehicle may safely and completely depart the lane. The test course shall have a start line that is made of retro-reflective tape, 12 inches wide, and long enough so that the vehicle will pass over it when the center of the vehicle is near the center of the lane. The start gate is defined by four pylons that are spaced 6 inches further than the width of the vehicle divided by 2. The cones should be spaced 20 ft. apart longitudinally from the starting point. The pylons should be placed so that the center of the start gate is 6 ft from the center of the lane line to be departed. Figure 3 graphically illustrates the test scenario for a left departure against a continuous white line.

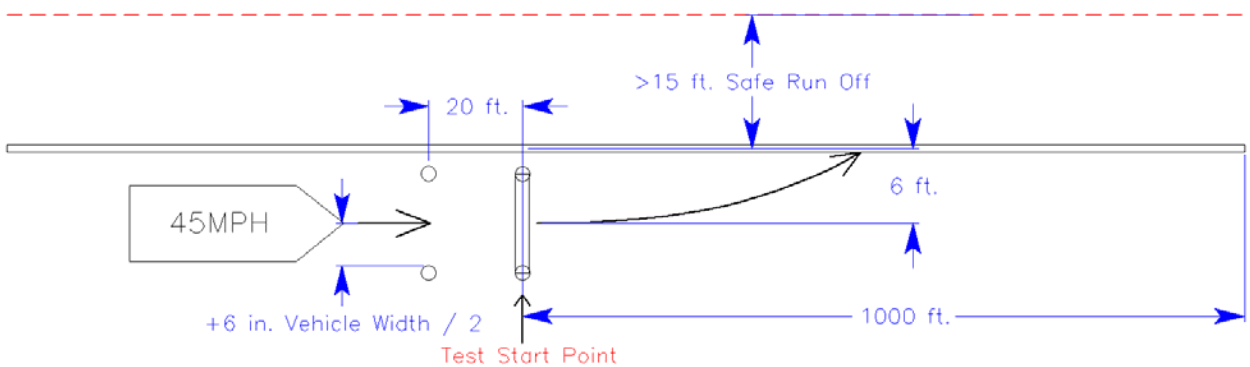

Figure 3 – Straight Road Lane Departure

This same test setup should be replicated with dashed yellow lines and continuous raised pavement markers. The test course should also be inverted to perform testing from the opposite direction.

12.2.1.2.2 Curved Scenario Test Setup

The curved test course shall be setup within an area that facilitates adequate area to allow the test vehicle to easily reach 45 mph, provide a minimum 1000 feet of area after the test starting point, and provide a safe amount of area laterally (>15 ft.) to ensure the vehicle may safely and completely depart the lane. The test course shall have a start line that is made of retro-reflective tape, 12 inches wide, and long enough so that the vehicle will pass over it when the center of the vehicle is near the center of the lane. The start gate is defined by four pylons that are spaced 6 inches further than the width of the vehicle divided by 2. The cones should be spaced 20 ft. apart longitudinally from the starting point. The pylons should be placed so that the center of the start gate is 6 ft from the center of the lane line to be departed. The start gate should be placed tangentially to the start of the curve. The curve radius should be between 400 and 600 ft. and curve to the right. Figure 4 graphically illustrates the test scenario for a left departure against a continuous white line.

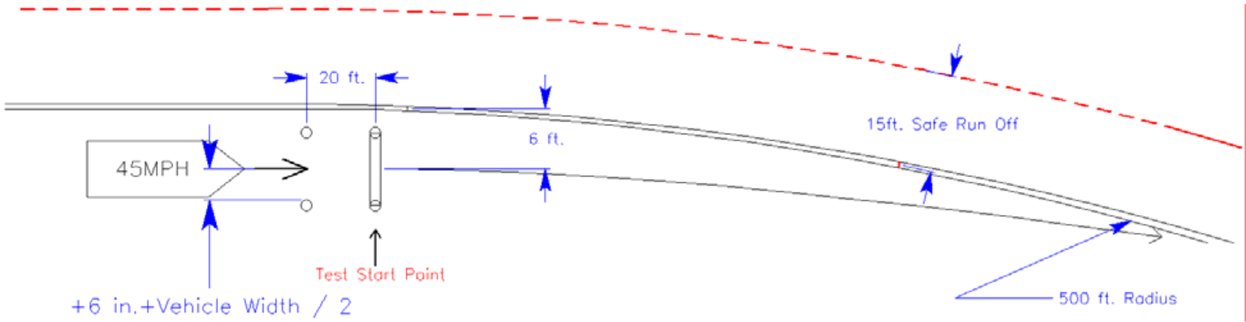

Figure 4 – Curved Road Lane Departure

This same test setup should be replicated with dashed yellow lines and continuous raised pavement markers. The test course should also be inverted to perform testing from the opposite direction.

12.2.2 Pass or Fail Criteria

The result from each trial will produce a pass or fail measure. The measure will be based upon the LDW producing an appropriate warning during the maneuver. It is known that LDW systems warn the driver on a simplistic range, range / range rate algorithm (time to line crossing (TLC)), or use a more complex TLC variant that factors in lateral velocity [4]. Given this fact, a pass fail criteria must accommodate this requirement. ISO attempts to define an early warning line and a latest warning line to accommodate for system algorithm differences [7]. Figure 5 is from the ISO standard.

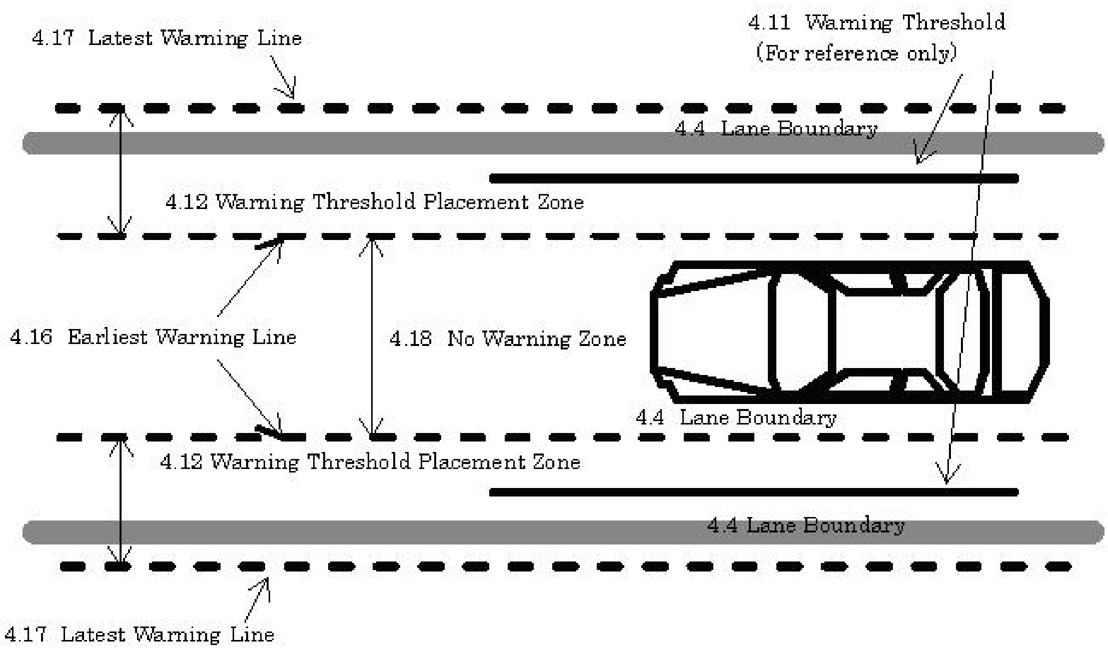

Figure 5. ISO warning placement zones as defined in ISO/DIS 17361 [7].

ISO defines the no warning zone as "the zone between the two earliest warning lines", with the earliest warning line being "the innermost limit of the warning threshold" on each side of the lane. The location of the allowable earliest warning line defined by ISO is dependent on the lateral drift rate as shown in Table 3, based on a similar graph and table in ISO DIS 17361.

Table 3. LDWS Earliest Warning Line Segment Definitions, as Shown in Figure 5.

Departure Rate (V)	Distance Between Vehicle and Lane Boundary
0.0 < V ≤ 0.5 m/s	0.75 m
0.5 < V ≤ 1.0 m/s	1.5 s × V m/s
1.0 m/s < V	1.5 m

In previous NHTSA sponsored work [4], a recommendation was made that regardless the algorithm, a warning be issued when the vehicles outside tire was between 50 cm (19.7 in.) inside the line to 50 cm outside the line. Additionally, the warning should occur before 50 cm inside the line at higher velocities (higher velocities are not explicitly defined) and at the same time they should never be issued before a 1 second TLC. This same work suggests an LDW should function between lateral velocities of 5cm/s and 100 cm/s (0.05 m/s to 1.0 m/s).

SAE J2808 – Uses ISO recommendations.
FMCSA - Uses ISO recommendations.

Figure 6. graphically illustrates a variety of the different recommended warning times on a single phase plane plot.

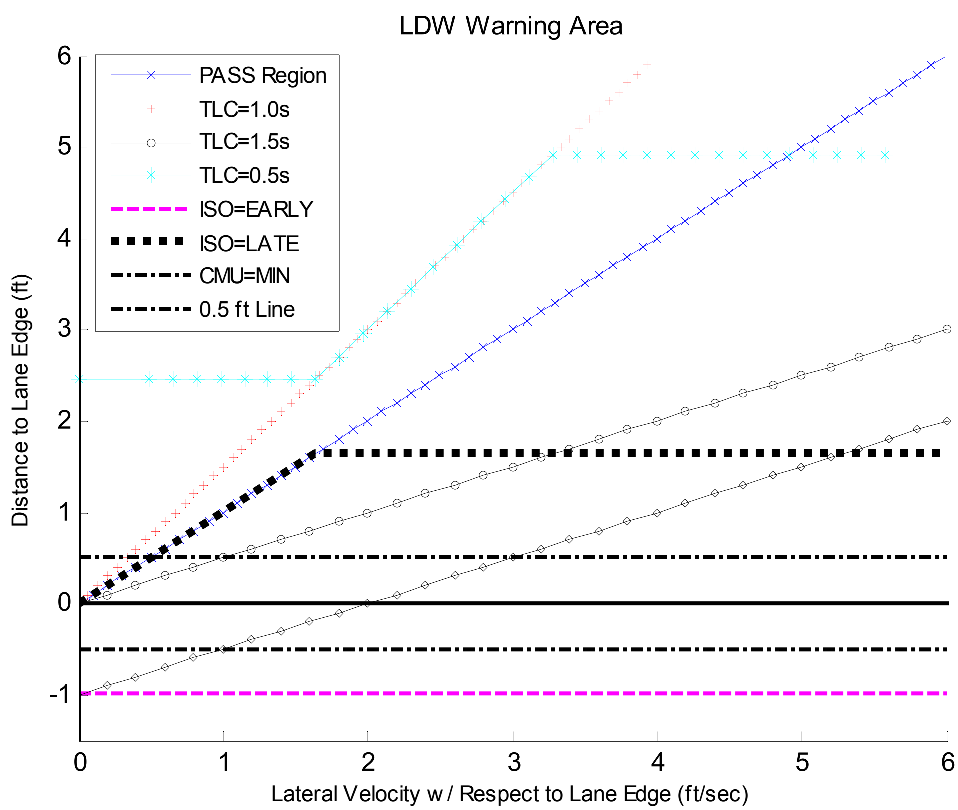

Figure 6

In this figure, several groups of warning criteria data can be observed. First, there are 3 traces that represent the basic TLC algorithms. These lines are completely linear with different slopes and are indicated by the “x” (TLC of 1.0 sec), the “+” (TLC of 1.5 sec), and the “o” (TLC of 0.5 sec.) The second group of warning lines represents the ISO recommended "earliest" and "latest" warning line [7]. These lines are represented by an "*" and a "-" respectively. The last warning line represented by the dotted "squares" represents the CMU minimum warning time, suggesting that warnings triggered more than 1 second or 1.64 feet (50 cm) prior to crossing the boundary will result in a large number of nuisance alarms [4].

From this data, the LDW pass fail criteria will be based on a combination of the above data as shown in the shaded area in figure 7. Using this figure, data points for lateral velocity and distance to the edge line at the time a warning is issued can be plotted. If the data at the time a warning is issued falls within the shaded area, the trial will be considered to have been successfully passed. If the data falls outside of the shaded area or no warning is issued, the trial will be considered to have been failed.

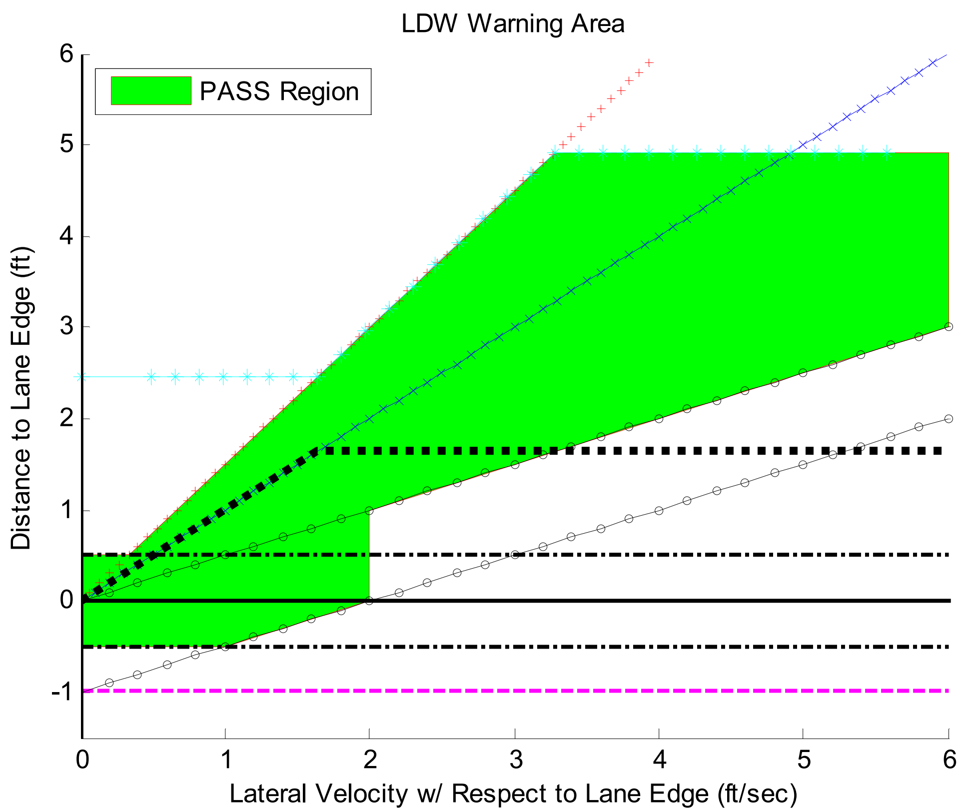

Figure 7

It is important to note several things in this graph. The pass/fail warning area requires that the warning be issued at least 0.5s before line crossing for lateral velocities above 2 ft/sec. This 0.5s criterion is based on previous research where alerted subjects best response during a lateral incursion was found to be 0.5 s or better [16].

A total of 120 trials are conducted. To be awarded a passing grade the LDW system must pass 2 of 5 trials for each individual test and overall pass 66 of 120 trials.

Looking at the overall pass / fail ratio, if any system scores less than 55% passing, the system will be considered as failing the test. Rationale behind this rating is based on RDCW FOT data [5,6] and NHTSA field data [13]. These studies found LDW availability to be around 55% to 60%. Availability is defined as the amount of time a system is operating correctly and able to support the driver

A total of 5 trials are repeated per test condition. If a system cannot pass more than 40% of any individual trial, the system will considered as failing the test. Rationale behind the rating is that a system must be able to function under every scenario proposed. Lane markings vary by region, state, city, etc. A system must work with all lane markings found in the U.S. The crash scenarios of “going straight and departing the road edge” and “negotiating a curve and departed the road edge” describe almost half (459K of 992K crashes) of all the target off-roadway pre-crash scenarios for all vehicles [9]. Additionally, the RDCWS FOT found that overall availability for LDW on non-freeway driving was 36% and on freeways was 76% [5]. Requiring a system to pass 40% of each scenario is very reasonable.

13. POST TEST REQUIREMENTS

Collect all data necessary to complete the final test report data sheets and provide details of any problem areas.

14. REPORTS

14.1 MONTHLY STATUS REPORTS

The Contractor shall submit a monthly Test Status Report and a Vehicle or Equipment Status Report to the COTR (both reports shown in this section). The Vehicle Status Report shall be submitted until all vehicles or items of equipment are disposed of.

14.2 TEST ANOMOLIES

In the event of an apparent test failure, a post-test calibration check of some critically sensitive test equipment and instrumentation may be required for verification of accuracy. The necessity for the calibration shall be at the COTR's discretion and shall be performed without additional costs to the OCAS.

14.3 FINAL TEST REPORT

14.3.1 COPIES

One(1) CD per test. Please add two items to the CD’s. Place a JPG of the vehicle in its test mode, – 180 by 300 pixels and around 10 KB. For the second item, place an example video on the CD.

One paper copy of each Final Test Report.

The above documentation shall be submitted to the COTR according to the schedule indicated in section 6.

Payment of Contractor's invoices for completed tests may be withheld until the Final Test Report is accepted by the COTR. Contractors are requested to NOT submit invoices before the COTR is provided copies of the Final Test Report.

Contractors are required to submit one color copy of each Final Test Report in draft form. DO NOT stamp *preliminary* or *draft* on this report. The COTR will review the draft report and notify the laboratory of any corrections that are required. If we agree to make changes to the test report, mail the appropriate (the changed) pages to us. We will insert the new pages into the preliminary test report. At the end, we will accept the preliminary test report with the inserted pages as the final test report.

Contractors are required to PROOF READ all Final Test Reports before submittal to the COTR. The OCAS will not act as a report quality control office for Contractors. Reports containing a significant number of errors will be returned to the Contractor for correction, and a "hold" will be placed on invoice payment for the particular test.

14.3.2 REQUIREMENTS

The Final Test Report, associated documentation (including photographs) is relied upon as the chronicle of the test. The Final Test Report will be released to the public domain after review and acceptance by the COTR. For these reasons, each final report must be a complete document capable of standing by itself.

The Contractor should use detailed descriptions of all test events. Any events that are not directly associated with the test program, but are of technical interest should also be included. The Contractor should include as much detail as possible in the report.

Instructions for the preparation of the first three pages of the final test report are provided below for the purpose of standardization.

14.3.3 FIRST THREE PAGES

Front Cover - - A heavy paperback cover (or transparency) shall be provided for the protection of the final report. The information required on the cover is as follows:

(A) Final Report Number such as OCAS-ABC-0X-001

where - -

OCAS is the Office of Crash Avoidance Standards
ABC are the initials for the laboratory
0X is the Fiscal Year of the test program
001 is the Group Number (00 1 for the 1st test, 002 for the 2nd test, 003for the 3rd test, etc.)

(B) Final Report Title And Subtitle such as

Lane Departure Warning Confirmation Test
****
World Motors Corporation
200X XYZ 4-door sedan
NHTSA No. CX0401

(C) Contractor's Name and Address such as

XYZ TESTING LABORATORIES, INC.
4335 West Dearborn Street
Detroit, Michigan 48090

NOTE: DOT SYMBOL WILL BE PLACED BETWEEN ITEMS (C) AND (D)

(D) Date of Final Report completion

(E) The words “FINAL REPORT”

(F) The sponsoring agency's name and address as follows

U. S. DEPARTMENT OF TRANSPORTATION
National Highway Traffic Safety Administration
Office of Crash Avoidance Standards
Mail Code: NVS-120
1200 New Jersey Avenue SE, Room W43-478
Washington, DC 20590

14. REPORTS.... Continued

First Page After Front Cover - - A disclaimer statement and an acceptance signature block for the COTR shall be provided as follows:

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Prepared By: ______________________________________

Approved By: ______________________________________

Approval Date: ______________________________________

FINAL REPORT ACCEPTANCE BY OCAS:

____
Manager,
NHTSA, Office of Crash Avoidance Standards

Date: ______________________________________

____
COTR, NHTSA, Office of Crash Avoidance Standards

Date: ______________________________________

14. REPORTS.... Continued

Second Page After Front Cover - - A completed Technical Report Documentation Page (Form DOT F1700.7) shall be completed for those items that are applicable with the other spaces left blank. Sample data for the applicable block numbers of the title page follows.

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OCAS-ABC-0X-001

Block No. 2 - - GOVERNMENT ACCESSION NUMBER

Leave blank

Block No. 3 - - RECIPIENT'S CATALOG NUMBER

Leave blank

Block No. 4 - - TITLE AND SUBTITLE

Final Report of OCAS Testing
of a 200X World XYZ Deluxe 4-door sedan
NHTSA No. CX0401

Block No. 5 - - REPORT DATE

March 1, 200X

Block No. 6 - - PERFORMING ORGANIZATION CODE

ABC

Block No. 7 - - AUTHOR(S)

John Smith, Project Manager
Bill Doe, Project Engineer

Block No. 8 - - PERFORMING ORGANIZATION REPORT NUMBER

ABC-DOT-XXX-001

Block No. 9 - - PERFORMING ORGANIZATION NAME AND ADDRESS

ABC Laboratories
405 Main Street
Detroit, MI 48070

14. REPORTS.... Continued

Block No. 10 - - WORK UNIT NUMBER

Leave blank

Block No. 11 - - CONTRACTOR GRANT NUMBER

DTNH22-0X-D-1 2345

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National Highway Traffic Safety Administration
Office of Crash Avoidance Standards
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1200 New Jersey Avenue SE, Room W43-478
Washington, DC 20590

Block No. 13 - - TYPE OF REPORT AND PERIOD COVERED

Final Test Report
XXX to XXX, 200X

Block No. 14 - - SPONSORING AGENCY CODE

NVS-120

Block No. 15 - - SUPPLEMENTARY NOTES

Leave blank

Block No. 16 - - ABSTRACT

These tests were conducted on the subject 200X World XYZ 4-door sedan in accordance with the specifications of the Office of Crash Avoidance Standards Test Procedure No. TP-OCAS-XX for the determination of vehicle lane departure warning performance.

Block No. 17 - - KEY WORDS

Lane Departure Warning test

14. REPORTS.... Continued

Block No. 18 - - DISTRIBUTION STATEMENT

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National Highway Traffic Safety Administration
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Unclassified

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Add appropriate number

Block No. 22 - - PRICE

Leave blank

14.3.4 TABLE OF CONTENTS .... PAGE NO.

Sample Test Report Table of Contents:

14.3.5 SAMPLE TEST REPORT INFORMATION

PURPOSE AND SUMMARY OF TEST

PURPOSE

This test is part of the a test program sponsored by the National Highway Traffic Safety Administration (NHTSA) under Contract No.____________. The purpose of this test was to obtain vehicle crash avoidance performance data for the Land Departure Warning.

SUMMARY

DATA SHEET NO. DESCRIPTION

1. Test Summary
2. General Test and Vehicle Parameter Data
3. Post test Data
4. Test Vehicle Information
5. Vehicle Measurements

15. DATA SHEETS

DATA SHEET NO. 1

TEST SUMMARY

Vehicle NHTSA No.: ____________________

Test Date: ______________________________ Time: ________________ Temperature: __________ °C

Vehicle Make/Model/Body Style: ____

Vehicle Test Weight: ______________________________ kg

Lane Departure Warning Confirmed ____________________

DATA SHEET NO. 2

GENERAL TEST AND VEHICLE PARAMETER DATA

TEST VEHICLE INFORMATION:

Year/Make/Model/Body Style: ______________________________

NHTSA No.: __________; VIN: ______________________; Color: __________

Engine Data: Cylinders; __________CID; ______Liters; __________cc

Transmission Data: ______speeds; ________Manual; __________Automatic; ________Overdrive

Final Drive: ___Rear Wheel Drive; ___Front Wheel Drive; __________Four Wheel Drive

Major Options: ______A/C; ________Pwr.Strg.; __________Pwr. Brakes

______Pwr. Windows; ______Pwr. Door Locks; ______ Tilt Wheel

Date Received: ________________; Odometer Reading ____________km

Dealer/leasee: ______________________________

& Address: ______________________________

DATA FROM VEHICLE'S CERTIFICATION LABEL:

Vehicle Manufactured by: ______________________________

Date of Manufacture ______________________________

GVWR: _______kg; GAWR: ________ kg FRONT; __________ kg REAR

DATA FROM TIRE OR TIRE PLACARD:

Tire Pressure with Maximum Capacity Vehicle Load: ____________kpa FRONT

____________ kpa REAR

Load Index & Speed Symbol: ____________________

Recommended Tire Size: ____________________

Recommended Cold Tire

* Pressure: ______________kpa FRONT; ____________kpa REAR

Tire Grades: __________

Treadwear; __________ Temperature; ____________ Traction

Size of Tires on Test Vehicle: ______________; Manufacturer: ______________

Vehicle Capacity Data:

Type of Front Seats: ____________Bench; ________Bucket; __________Split Bench

Number of Occupants: ________ Front; ________ Rear; 0 __________ Total

Vehicle Capacity Weight (VCW) = ______________kg

No. of Occupants x 68 kg = ______________kg

Rated Cargo/Luggage Weight (RCLW) = ______________kg

*Tire pressure used for test

WEIGHT OF TEST VEHICLE AS RECEIVED FROM DEALER (with maximum fluids) = UDW:

Right Front = ____________________kg Right Rear = _______________kg

Left Front = ____________________kg Left Rear = _______________kg

TOTAL FRONT = ____________________kg TOTAL REAR = _______________kg

TOTAL DELIVERED WEIGHT = ____________Kg

% of Total Front of Vehicle Weight = _______% of Total Rear Weight = _________%

WEIGHT OF TEST VEHICLE

Right Front = ____________________kg Right Rear = _______________kg

Left Front = ____________________kg Left Rear = _______________kg

TOTAL FRONT = ____________________kg TOTAL REAR = _______________kg

TOTAL TEST WEIGHT = _________Kg

% of Total Front Weight = ________% % of Total Rear Weight = ____________%

FUEL SYSTEM DATA :

Fuel System Capacity From Owner's Manual = ____________ liters

Usable Capacity Figure Furnished by COTR = ____________ liters

Test Volume Range (75 % to 100% of Usable Capacity) = __________ to _________ liters

ACTUAL TEST VOLUME= ____________ liters (with entire fuel system filled)

<u>DATA SHEET NO. 3</u>

PHOTOGRAPHS

REFERENCES

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